3.5

OPERATING INSTRUCTIONS

MODEL TTS 15B and TTS 15C
TRANSMISSION TEST SETS

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Airport Road
Concord, New Hampshire

MODELS TTS 15B AND TTS 15C TRANSMISSION TEST SETS

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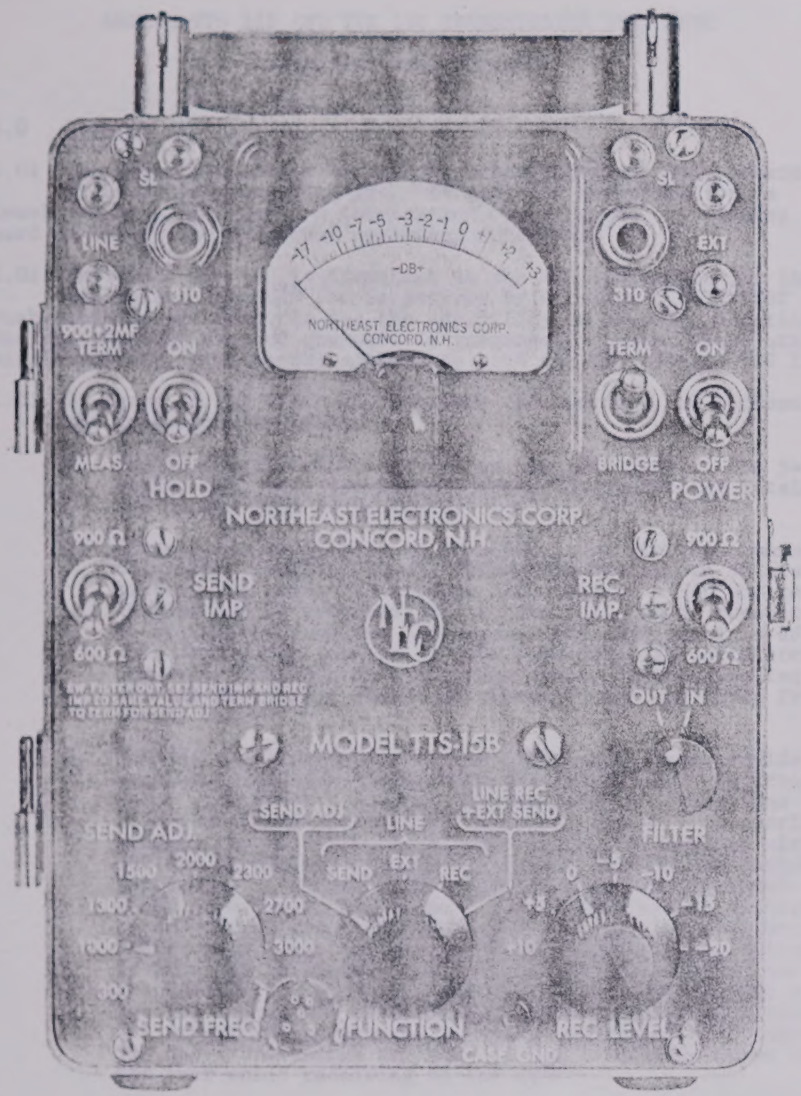
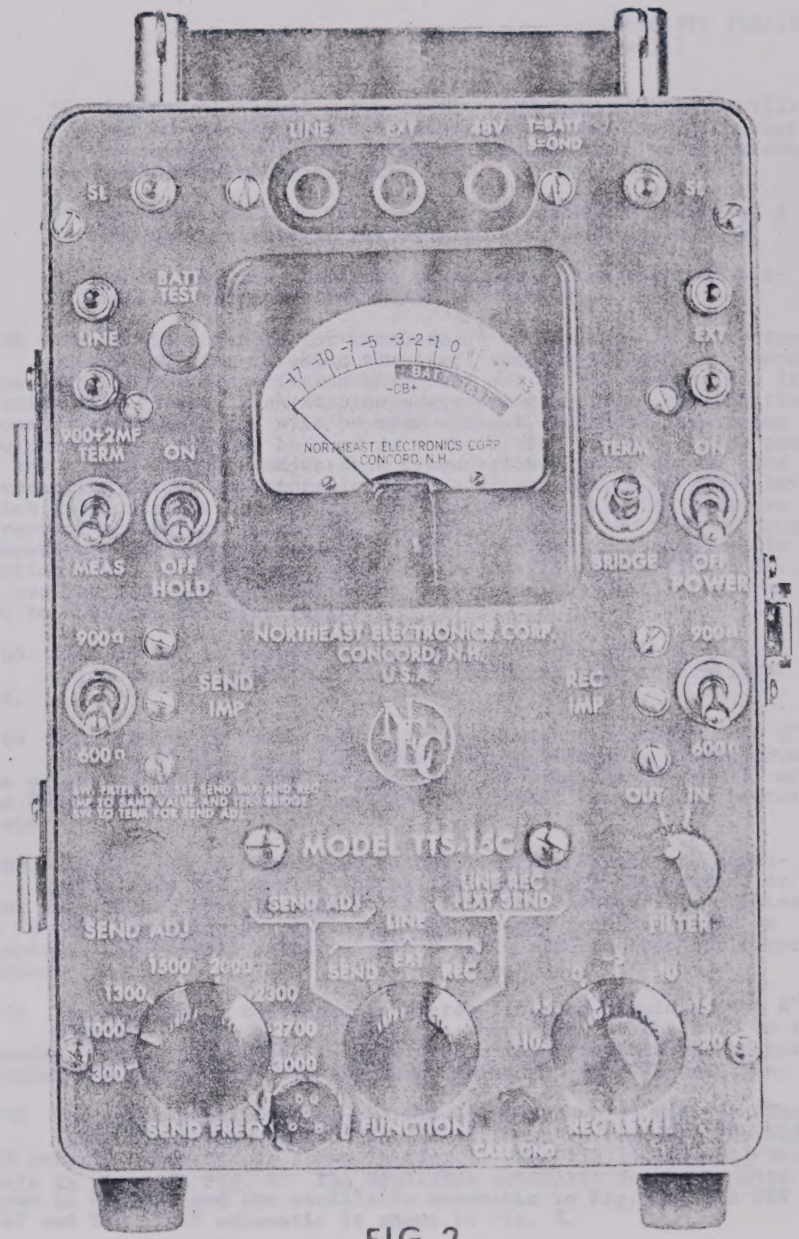

SL
LINE
310
900+2MF TERM
ON
MEAS
OFF HOLD
-DB+
NORTHEAST ELECTRONICS CORP.
CONCORD, N.H.
SL
EXT
310
TERM
ON
BRIDGE
OFF POWER
NORTHEAST ELECTRONICS CORP.
CONCORD, N.H.
900Ω
600Ω
SEND IMP
REC. IMP.
OUT IN
MODEL TTS-15B
SEND ADJ.
LINE REC
EXT SEND
LINE
SEND EXT REC
FILTER
SEND FREQ
FUNCTION
REC LEVEL

FIG. 1


LINE
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SEND ADJ.
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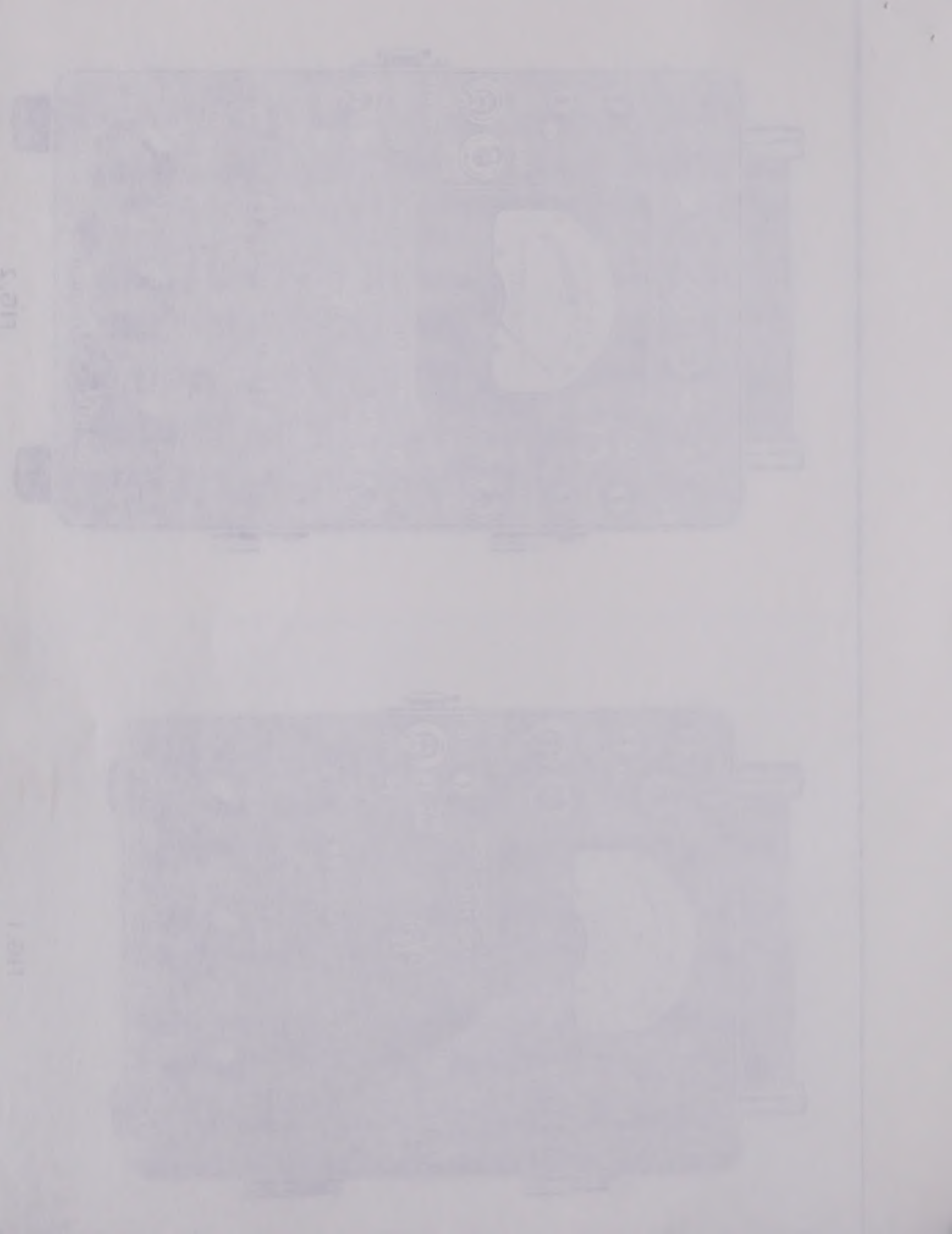
FILTER
SEND FREQ
FUNCTION
REC LEVEL

FIG. 2



MODELS TTS 15B AND TTS 15C TRANSMISSION TEST SETS

OPERATING INSTRUCTIONS

1.0 GENERAL

1.01 The Model TTS 15B is a compact, transistorized, self-powered transmission measuring set. It contains an oscillator, a level meter, a hold coil, a termination, and a group of switches used to select the different measuring functions.

1.02 The Model TTS 15C is identical to the TTS 15B except for the following: The TTS 15C is powered by D cells, a BATT TEST pushbutton is provided, it has the capability of 48-volt operation, and the physical size of the unit is increased. Except where otherwise specified, this manual applies to both the TTS 15B and TTS 15C.

1.03 By means of the different switches the operator can perform the following functions:

1. Extend the circuit connected to the LINE jack to the jack marked EXT, thus providing a means for connecting a talk set to the line to be tested.

2. Connect the oscillator to the LINE jack. In this connection eight constant level, fixed frequencies can be transmitted. By means of switches a 600 ohm or a 900 ohm termination can be provided, and a hold coil can be connected to or removed from the LINE jack. The SEND level is adjustable from 0 dbm down to -37 dbm. An optional oscillator network, contained on a separate panel, can be supplied to provide continuous frequency coverage over the voice frequency band.

3. Connect the level meter to the LINE jack. This provides a means to measure levels from +13 to -37 dbm. An attenuator with seven 5 db steps is provided to control the level measuring sensitivity; this provides a 5 db overlap between ranges. The level meter can be operated on either 600 ohm or 900 ohm circuits; a switch selects the desired impedance. A second switch permits selection of terminated or bridging operation. A hold coil can be connected to or removed from the LINE jack. For use in locations where power line interference exists, a high pass filter is provided to attenuate the 60 cps power frequency and its harmonics. A FILTER switch is provided to either remove or insert the filter; operation of this switch does not affect the reading of the meter for frequencies above 500 cps. Provisions are made to enable monitoring on the EXT jack while receiving on the LINE.

4. Provide an internal connection from the oscillator to the level meter. This permits setting up any desired SEND level for the SEND function.

5. Connect the level meter to the LINE jack and the oscillator to the EXT jack. This permits direct insertion loss measurements of four terminal networks such as transformers, pads, cord circuits, etc.

6. Transfer the LINE jack to a termination consisting of a 900 ohm resistor in series with a 2.0 mfd capacitor.

7. In the TTS 15C check the condition of the internal batteries, using the BATT TEST pushbutton.

1.04 The set is suitable for measurement on any type of voice frequency facility in which the level exceeds -37 dbm. In connection with another transmission measuring set at the distant end it permits straightaway transmission measurements between two locations. Looped measurements can also be made without additional measuring equipment. The set may be used as a calibrated source of test power at any of its fixed or adjustable frequencies, and it may be used as a measuring device in connection with a signal source of known level which is located at the distant end of the circuit. The basic accuracy of the set for both SEND and REC is within ±0.25 db at room temperature for voice frequency; detailed information is given in Section 2.0. An accessory panel, the Model TTS 15XV or TTS 15CXV, is available to provide continuous tuning for the oscillator from 200 to 7000 cps in three ranges.

1.05 The TTS 15B is powered by two Eveready Type 2356 batteries which provide a battery life of 100 hours with intermittent use.

1.06 The TTS 15B is contained in a gray finished aluminum case 6" wide by 8" high by 5 7/8" deep, with a removable hinged cover. The weight of the unit is 7 1/2 pounds. Closing the cover will move the POWER switch to the OFF position to prevent unnecessary battery drain.

1.07 The TTS 15C is powered by either internal batteries, accessible from the rear of the set by removing a back cover, or from an external 48-volt supply. An internal regulator is utilized on 48-volt operation to eliminate interference from any noise or ripple on the 48-volt battery. Ten D cells are required for internal batteries.

1.08 The TTS 15C is contained in a gray finished aluminum case 6" wide by 9" high by 7 1/2" deep. The weight of the unit is ten pounds. Storage for cords is provided in the removable hinged cover. Closing the cover will move the POWER switch to the OFF position.

1.09 The front panel view of the TTS 15B is shown in Fig. 1. The front panel view of the TTS 15C is shown in Fig. 2. The TTS 15B overall schematic is shown in Fig. 3. The TTS 15C overall schematic is shown in Fig. 4. The amplifier schematic for both units is shown in Fig. 5, and the oscillator schematic in Fig. 6. The TTS 15XV and TTS 15CXV schematic is shown in Fig. 8.

2.0 PERFORMANCE DATA

Oscillator Section

2.01 The oscillator section features and performance are:

Frequencies: Eight fixed frequencies selected by a switch -- 300, 1000, 1300, 1500, 2000, 2300, 2700, and 3000 cps.

Two extra fixed frequencies are available on special order.

One position provides for connecting external frequency determining networks -- an optional variable frequency network mounted in a special cover and covering 200 to 7000 cps is available.

Frequency Accuracy:

Fixed frequency ±2% from 50° to 100°F.
Variable frequency ±3% from 50° to 100°F.

Distortion: Less than 1% at any harmonic.

Level Variation with Frequency:

Less than ±0.2 db for fixed frequencies.
Less than ±0.3 db for variable frequency.
Level can be recalibrated by switching to SEND ADJ position.

Output Level: Can be set by means of the SEND LEVEL adjustment and calibrated for any level between 0 and -30 dbm. At reduced accuracies the SEND LEVEL can be adjusted down to -37 dbm.

Output Impedance: The SEND impedance can be switched to 600 or 900 ohms. At 1000 cps these impedance values are within ±5% of the nominal impedance.

Send on LINE jack: A low resistance hold coil (500 ohms) can be switched ON or OFF. A 2000 ohm resistor is connected across the LINE jack whenever the SEND provision is used. The maximum DC rating is 60 volts while sending on the LINE jack. The LINE jack can be transferred to a 900 ohm +2.0 mfd termination.

Send on EXT Jack: DC blocking and a 2000 ohm resistance hold circuit are provided. The maximum DC rating is 60 volts while sending on the EXT jack.

Other send frequencies can be provided.

Substitution of another fixed frequency does not alter the basic operation of the set and, except for the change in value of the frequency determining resistors, this manual remains applicable.

Receiving Section

2.02 The receiving section features and performance are:

Meter: 0.2 db divisions from +3 db to -3 db.
0.5 db divisions from -3 to -7 db.
1.0 db divisions from -7 db to -17 db.

Range of Measurements: +13 dbm to -37 dbm.

Frequency Response: Variations from 1000 cps response:

Filter OUT ≦ ±0.25 db from 200 to 15,000 cps
≦ ±0.5 db from 100 to 20,000 cps

Filter IN ≦ ±0.25 db from 500 to 15,000 cps
60 cps attenuated at least 30 db

Calibration: An external calibration control is provided to set the meter precisely on 0 db when an accurate 0 dbm signal is applied to the LINE jack.

Stability of Calibration: Changes referred to measurements at 70°F on representative set.

Temperature Errors: Typical performance at 0 db on meter; 50° to 120°F -- less than ±0.1 db change from 70° reading.

Supply Voltage Errors: Typical performance at 0 db on meter. Less than ±0.1 db change from 18 volts to 12 volts.

Input Impedance:

Terminated: 600 ohms ±5% or 900 ohms ±5% at 1000 cps; impedance selected by switch.

Bridging: Filter OUT ≧ 15,000 ohms for either 600 or 900 ohm bridging.

Filter IN ≧ 8000 ohms for either 600 or 900 ohm bridging.

The receive section utilizes a tapped and balanced transformer and contains a DC blocking condenser rated at 150 volts.

Receive on LINE Jack: A hold coil with 500 ohms DC resistance can be switched ON or OFF. The LINE jack can be transferred to a 900 ohm +2.0 mfd termination. A signal received on the LINE jack can be monitored on the EXT jack when the FUNCTION switch is in the REC position.

3.0 CIRCUIT DESCRIPTION

3.01 The schematic diagram of the set is shown in Figs. 3 and 4. The detailed description of the amplifier and oscillator section is contained in the following paragraphs, and appropriate schematics are shown in Figs. 5 and 6 respectively.

Receiving Section

3.02 As shown in Figs. 3 and 4, the receiving section of this set consists of transformer T01, a switchable hold coil, a switchable high pass filter, an attenuator, a meter drive amplifier, a bridge rectifier, and a DC meter.

3.03 The primary of transformer T01 has two balanced and tapped windings; this permits operation of 600 or 900 ohms and provides a balanced circuit which is blocked for DC by condenser C101. During bridging operations the transformer secondary is connected to a 25,000 ohm attenuator, either directly or through a high impedance high pass filter. When the high pass filter is switched out of the circuit, a resistor, R03, is added to the circuit to compensate for the filter insertion loss. When the set is used in the terminated condition, resistor R01 terminates the secondary of transformer T01, thereby making the input impedance of the receive section either 600 or 900 ohms, as determined by the position of the REC IMP selector switch, and resistor R02 is shorted to compensate for the increased voltage drop in the internal impedance of the transformer.

3.04 The amplifier driving the meter is a conventional transistor amplifier using NPN transistors. The rectifier bridge which supplies DC to the meter is inserted in the amplifier feedback path. The use of negative feedback provides stability of the effective gain with variations of temperature and battery voltage.

Oscillator and Buffer Amplifier Section

3.05 As shown in Fig. 6, the bridged-T oscillator uses three PNP transistor stages. The first two are direct coupled from the collector of Q101 to the base of Q102. The positive feedback path is completed from the emitter of Q102 back through LP101, a tungsten bulb used for level stabilization, to the emitter of Q101. The emitter resistor of Q101 is variable to permit factory setting of the correct amount of positive feedback necessary for stable operation. A negative feedback which is normally greater than the positive feedback is supplied to the base of Q101 through a null selective network and an emitter follower, Q103. The selective bridged-T null network decreases the negative feedback sufficiently to permit oscillation to occur at the desired frequency, which is determined by the values in the bridged-T circuit. For the fixed frequencies this frequency determining network consists of two selected value, parallel connected capacitances, C152, C154, and C153, C155, and two resistors selected by SEND FREQ selector switch S301. For the variable frequency

this frequency determining network consists of two selected value, parallel connected capacitances, C152, C154, and C153, C155, and the frequency determining network shown in Fig. 8.

3.06 As shown in Fig. 6, the buffer amplifier uses a single PNP transistor in a common emitter circuit. The oscillator voltage obtained at the emitter of Q102 is connected to the base of Q104 through level control P01. This arrangement permits adjustment for all levels from -37 to 0 db. The collector load of Q104 consists of two resistors, P103 and P104. These are used in connection with the two position SEND IMP switch to select either a 600 or a 900 ohm output impedance. This circuit is coupled to the output jack through a DC blocking condenser, C158. The 2000 ohm resistor, R161, is connected across the oscillator output at all times; it provides a holding feature when the oscillator output is supplied to the EXT jack.

Power Supply Circuits

3.07 The oscillator and amplifier are each decoupled from the common battery to eliminate feedback between the two circuits. Each decoupling network consists of a 47 ohm resistor and a 100 mfd capacitor. The use of two different types of transistors requires the amplifier battery polarity to be reversed from the oscillator battery. Therefore, to simplify wiring, the amplifier decoupling was placed in the ground circuit.

3.08 Normal operation of the oscillator and amplifier requires a power supply voltage of 18 volts. Therefore, to utilize power from a 48-volt source in the TTS 15C, a voltage dividing regulator, shown in Fig. 4, is used. The input to the regulator is diode protected to prevent damage to the circuit in the event the wrong polarity is applied. The output voltage of this regulator is 18 volts and is virtually independent of any voltage changes or ripple that may be present on the 48-volt supply. The supply voltage may range between 40 and 52 volts without affecting the performance of the set.

3.09 The battery test circuit, as shown in the overall schematic of the TTS 15C, consists of R05 and S09. The meter scale has a green arc designated BATT TEST. When the BATT TEST pushbutton is depressed the meter is connected to the internal batteries through R05. When the battery voltage reaches the 12-volt cut off point the meter will no longer register in the green arc.

4.0 CONTROLS, SWITCHES, JACKS, AND TERMINALS

4.01 The following controls are provided:

1. REC LEVEL step attenuator with 5 db steps covering +10 to -20 db.
2. REC IMP switch to select 600 ohm or 900 ohm RECEIVE impedance.
3. TERM/BRIDGE switch to transfer the level measuring section impedance from TERMINATED to BRIDGING.
4. FILTER IN/OUT to switch high pass filter IN or OUT.
5. SEND FREQ selector switch.
6. SEND LEVEL adjustment.
7. SEND IMP switch to select 600 ohm or 900 ohm SEND impedance.
8. POWER ON/OFF switch.
9. FUNCTION switch. This switch has 5 positions, namely:
   a) LINE REC/EXT SEND - connects the level measuring section to the LINE jack and simultaneously connects the oscillator to the EXT jack.
   b) LINE/REC - connects the level measuring section to the LINE jack and connects the EXT jack to the receiver output for monitoring.
   c) LINE/EXT - connects the LINE jack directly to the EXT jack.
   d) LINE/SEND - connects the oscillator to the LINE jack.
   e) SEND ADJ - connects the oscillator to the level measuring section to permit calibration of the SEND level.
10. MEAS/900+2MF TERM switch to transfer the LINE jack to a 900 ohm +2.0 mfd termination.
11. HOLD ON/OFF switch for the hold coil on the LINE jack.

4.02 The following jacks and terminals are provided:

1. Two binding posts and a 310 jack for the LINE.
2. Two binding posts and a 310 jack for the EXT.

3. A binding post for the sleeve of each of the two 310 jacks.
4. A pin jack for case ground.
5. A connector for external oscillator networks.
6. A 310 jack for connecting an external 48 volt supply on the TTS 15C.

5.0 CALIBRATION

5.01 With the POWER switch in the OFF position, check the mechanical zero of the meter. If correction is needed, a small adjustment can be made to the mechanical zero screw on the face of the meter.

5.02 Check the condition of the batteries as in paragraph 7.01 or 7.04.

5.03 The calibration of the receiving section requires a 600 or 900 ohm source of 1000 cps sine wave at one milliwatt of power. Unless this source is known to be accurate, it should be recalibrated to provide exactly one milliwatt of output power. The NEC Model TTS 4AN Transmission Test Set or equivalent may be used for this purpose.

5.04 The FUNCTION switch is moved to the REC position, the filter switch is moved to the OUT position, the IMP switch is moved to match the impedance of the power source, and the LINE terminals or jack are connected to the source. If, with the POWER switch in the ON position and the REC LEVEL control at 0, the meter does not read 0 dbm while correct battery voltage is present, remove the unit from its case, readjust P101 to obtain a 0 db reading, replace the unit in its case, and make sure that the meter still reads precisely 0 db. The position of P101 should be secured by applying glyptol cement to its shaft.

6.0 OPERATION

6.01 Initial Steps

1. Turn power ON.
2. Move the HOLD switch to the OFF position.
3. Connect the line to be measured to the LINE jack.
4. Connect the TEL SET to the EXT jack.

The instrument is now set up to send or receive signals on the LINE jacks, or to make calls on the line.

6.02 To Measure Tone

1. Set the REC LEVEL to +10, the REC IMP to the desired impedance, i.e., 600 or 900 ohms, and the TERM/BRIDGE switch to the desired mode of operation.
2. Set the FUNCTION switch to the EXT position and call for tone at the distant end with the external TEL SET.
3. Move the HOLD switch to ON when tone is received.
4. Turn the FUNCTION switch to the REC position.
5. Turn the REC LEVEL switch to obtain a convenient reading on the meter (between -3 and +3 marks if possible).
6. The measured level is the algebraic sum of the REC LEVEL dial setting and the meter reading. Black figures on the meter carry a minus (-) sign; red figures carry a plus (+) sign.

   Examples:

   REC LEVEL attenuator set for -5; meter reads -2.5 db; the received level is -7.5 dbm.

   REC LEVEL attenuator set for -5; meter reads +1.5 db; the received level is -3.5 dbm.

   REC LEVEL attenuator set for +5; meter reads -2.5 db; the received level is +2.5 dbm.

   REC LEVEL attenuator set for +5; meter reads +1.5 db; the received level is +6.5 dbm.

7. The signal may be monitored by a TEL SET connected to the EXT jack.

6.03 To Send Tone on LINE Jack

1. Set both IMP switches to the desired impedance.

2. Set the SEND FREQ switch to the desired frequency.

3. Calibrate the sending power. The sending power is adjusted by using the receiving section for a reference. Set both the SEND and REC IMP switches to the impedance of the circuit to which the SEND signals will be supplied, set the BRIDGE/TERM switch to the TERM position, and set the FUNCTION switch to SEND ADJ. Adjust the SEND level to the desired value, using the SEND LEVEL ADJ control. No further SEND calibration steps are required. As the variation in sending power over the frequency range is normally not more than 0.1 db, calibration at the individual frequencies is not usually required.

   CAUTION: If the SEND IMP is changed, the output level must be reset as above.

4. Turn the FUNCTION switch to SEND. This connects the output of the oscillator to the LINE jack. The sending power will thereafter be independent of further changes in the position of the REC LEVEL switch.

6.04 To Send and Receive Simultaneously

1. The set may be used to determine insertion loss of four terminal networks such as filters, transformers, cord circuits, etc. It is possible to measure insertion loss of networks which have 600 or 900 ohm impedances and of networks which have one set of terminals with a 600 ohm impedance, while the other set has a 900 ohm impedance. Certain procedures must be followed to obtain the correct answers, particularly when unequal impedances are involved.

2. Connect the line to be measured or the output terminals of the equipment to be tested to the LINE jack.

3. Connect the line on which tones are to be sent or the input terminals of the equipment to be tested to the EXT jack.

4. Calibrate the sending power as in paragraph 6.03, using the impedance setting corresponding to the line or network input connected to the EXT jack.

   CAUTION: Do NOT change position of SEND IMP switch after completing Step 3.

5. Set the FUNCTION switch to the position marked LINE REC +EXT SEND and the REC IMP switch to the position corresponding to the impedance connected to the LINE jack. The set is now set up to make measurements of incoming signals on the LINE jack, and to send tones on the EXT jack.

6. Turn the REC LEVEL switch to obtain a convenient reading on the meter. The level is determined as in paragraph 6.02.

6.05 To Connect the Termination to the Line

1. Connect the line to the LINE jack.

2. Set the MEAS/900+2MF TERM switch to 900+2MF TERM.

7.0 MAINTENANCE

7.01 Normally the set should need no maintenance other than replacing worn out batteries and checking its REC LEVEL calibration. The condition of the battery is tested in the TTS 15B by the following steps:

1. Set both IMP switches to 600.
2. Turn the FUNCTION switch to the SEND ADJ position.
3. Set the REC LEVEL control to 0 dbm.
4. Set the FILTER switch to the OUT position.
5. Turn the SEND ADJ control fully clockwise.
6. Turn the POWER switch ON.

The meter should then read +1.5 db or higher; if it does not, replace the batteries with Eveready 2356 or equivalent. To replace the batteries it is necessary to remove the unit from its case and to remove the screws from the bottom of the case to free the battery clamp.

7.02 If a voltmeter is used to check the battery condition, the battery should be replaced when its voltage is less than 12 volts with the POWER switch in the ON position and the FUNCTION switch in the SEND ADJ position.

7.03 Fresh Eveready 2356 or equivalent batteries provide a normal battery life of at least 100 hours with intermittent use.

7.04 In the case of the TTS 15C the condition of the batteries are checked by the use of the BATT TEST pushbutton as follows:

1. Turn POWER switch ON.
2. Depress BATT TEST pushbutton.

The meter should fall within the green arc; if it does not, replace the batteries with D cells. To replace the batteries remove the back cover from the unit.

7.05 Fresh D cells provide a normal battery life of 150 hours with intermittent use.

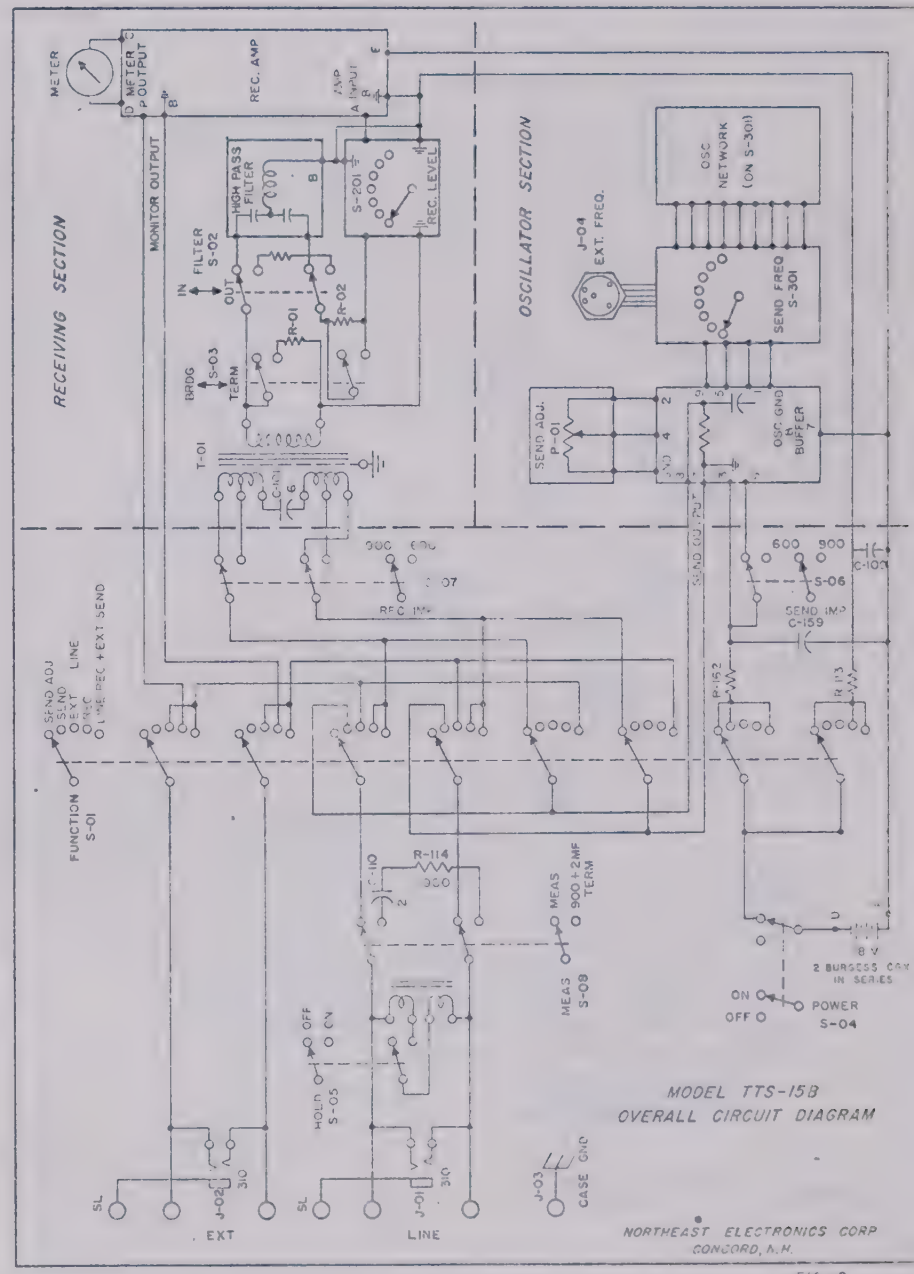


FIG-5

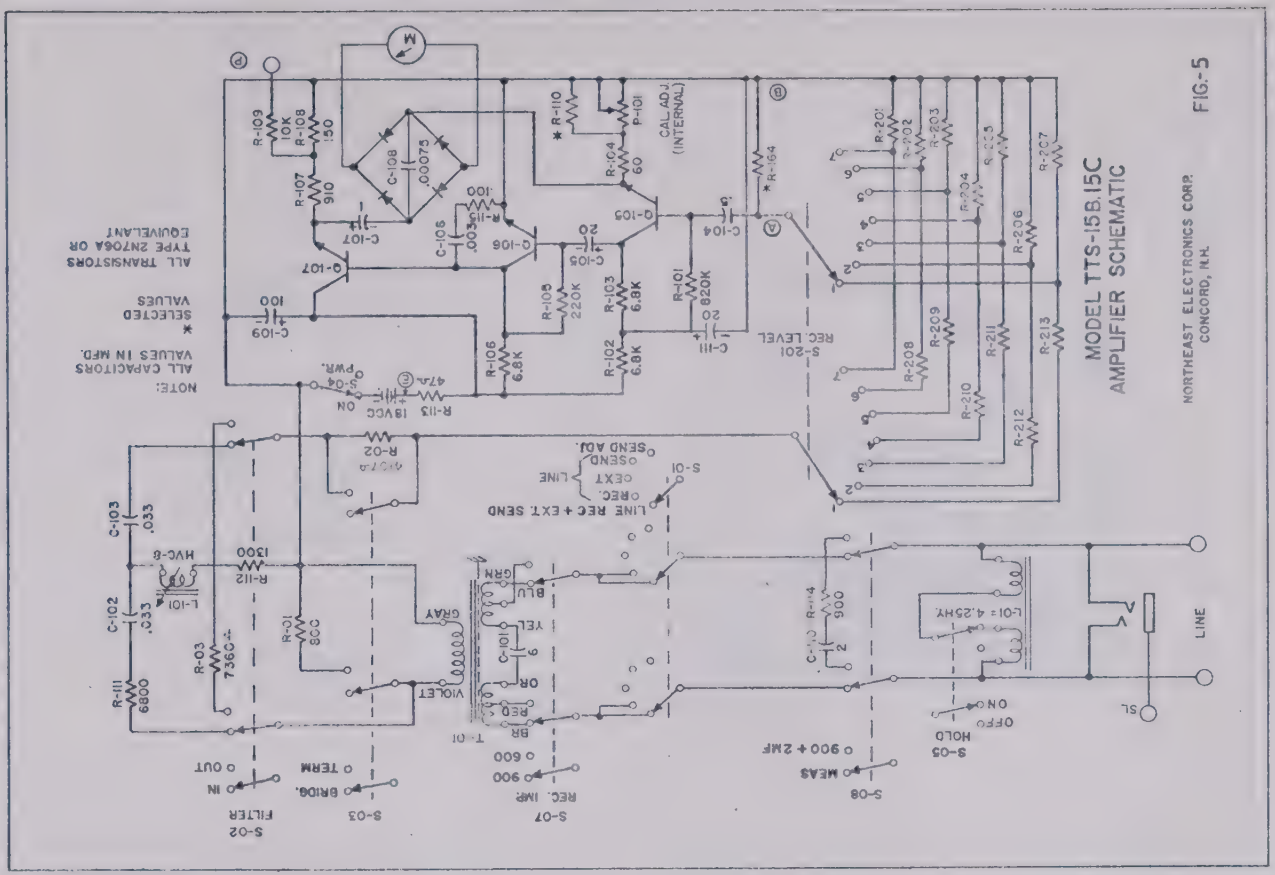
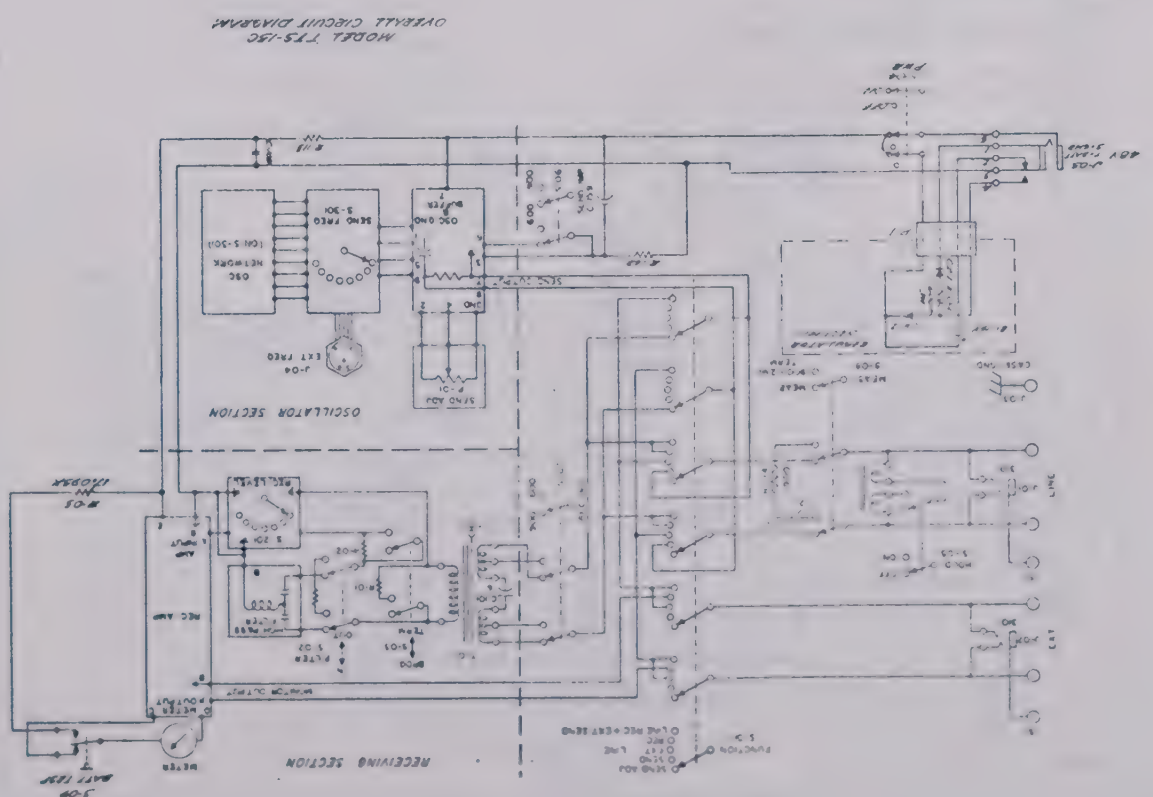
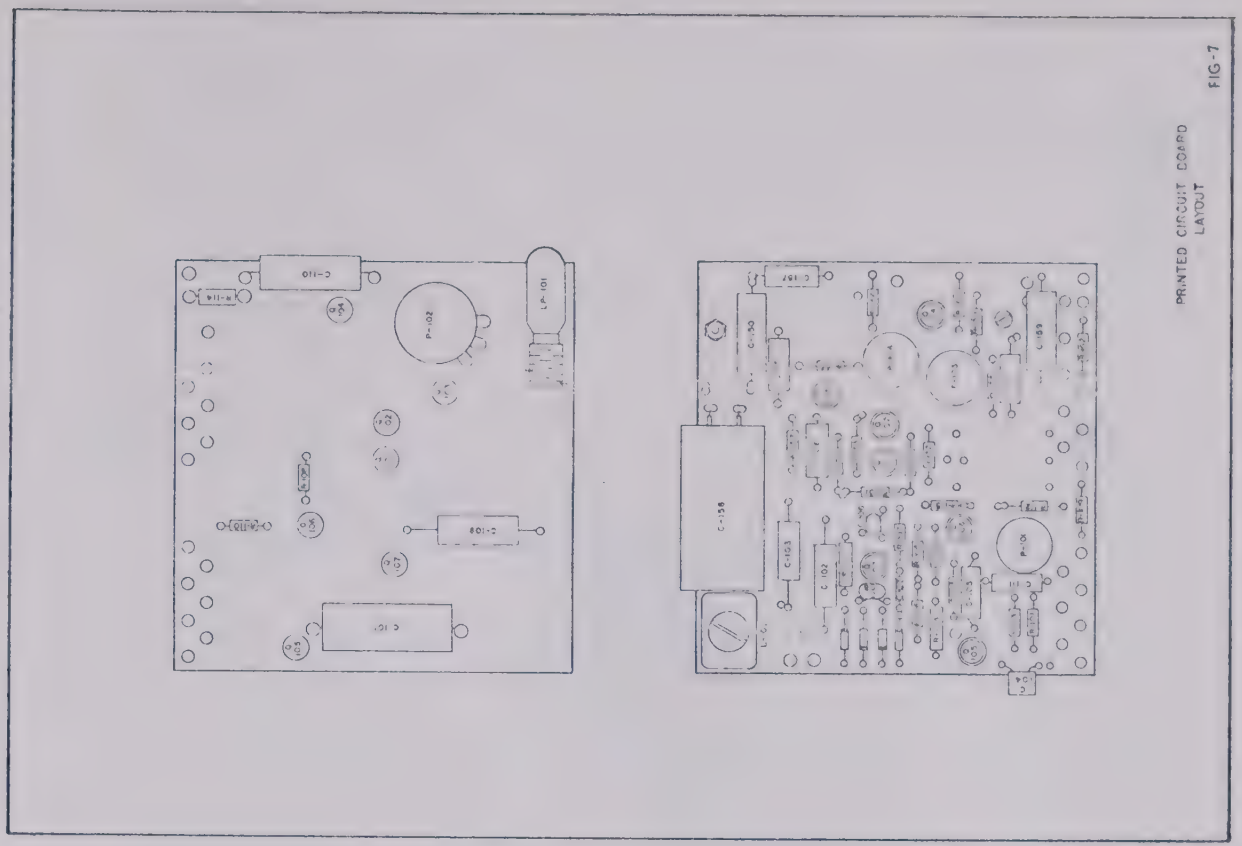

MODEL TTS-15B.15C
AMPLIFIER SCHEMATIC
NORTHEAST ELECTRONICS CORP.
CONCORD, N.H.
FIG.-5
ALL TRANSISTORS TYPE 2N706A OR EQUIVALENT
NOTE: ALL CAPACITORS VALUES IN MFD.
* SELECTED VALUES
LINE REC + EXT. SEND
REC. LEVEL
CAL ADJ (INTERNAL)
LINE
S-01
S-02 FILTER
S-03
S-07 REC. IMP.
S-08
S-03 HOLD

FIG. 4


MODEL TTS-15C
OVERALL CIRCUIT DIAGRAM
OSCILLATOR SECTION
RECEIVING SECTION



PRINTED CIRCUIT BOARD LAYOUT

FIG-7

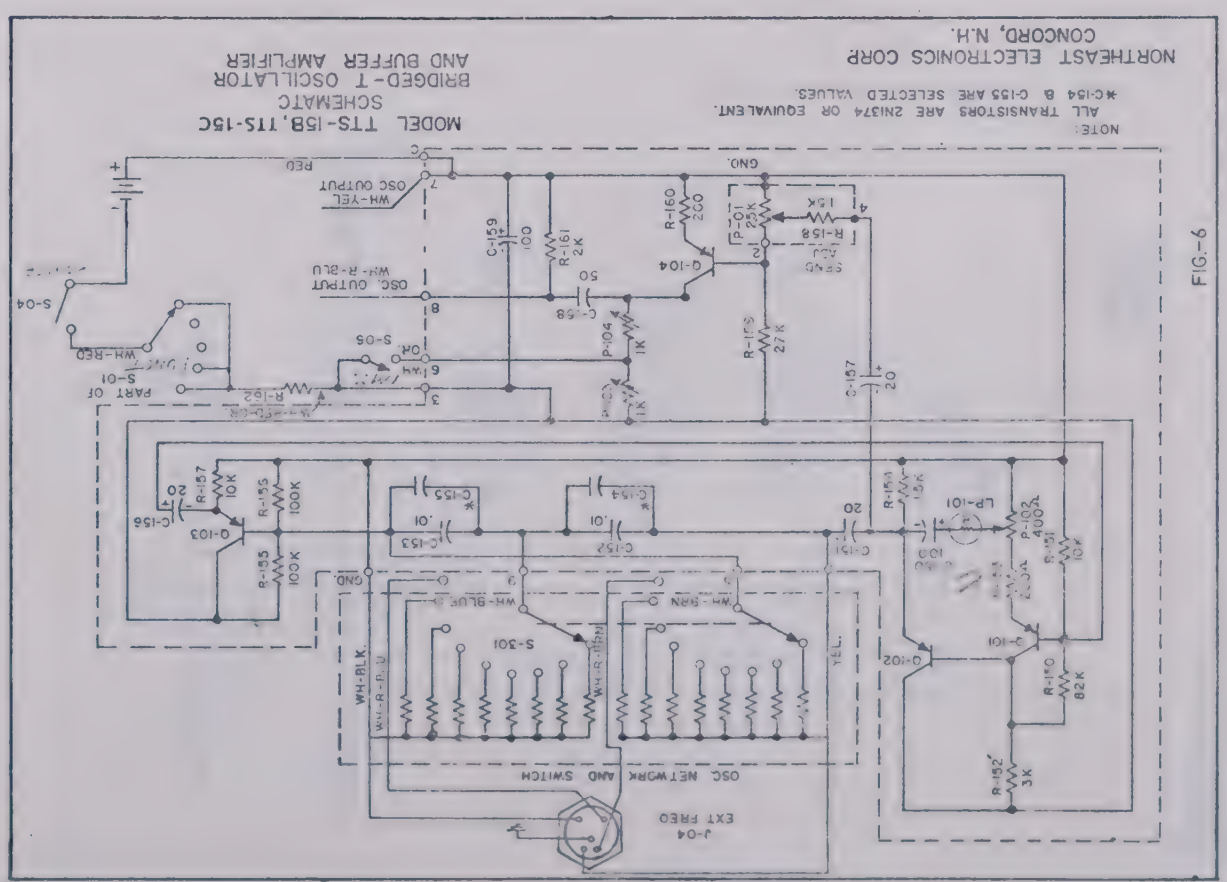
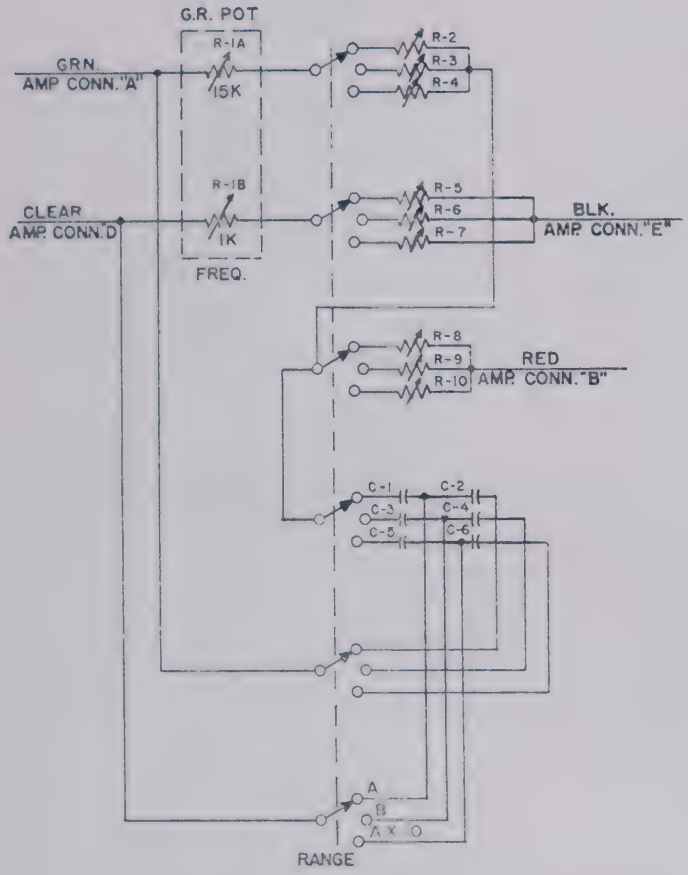


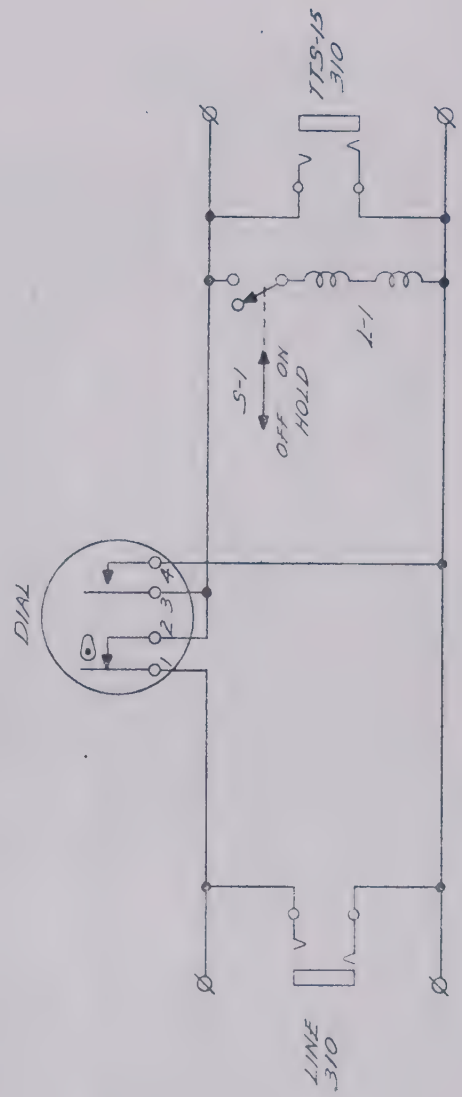
FIG-6



SCHEMATIC
TTS-15BXV
TTS-15CXV

NORTHEAST ELECTRONICS CORP.
CONCORD, N.H.

FIG.-8



SCHEMATIC
TTS-15XDH

FIG.-9

TABLE OF REPLACEABLE PARTS

Circuit Ref	Description	Mfr* & Mfr's Designation
C101	Capacitor: fixed, paper, 6 mfd, 150 vdc	R, 121P60591R5[illegible]
C102	Capacitor: fixed, paper, .033 mfd, 600 vdc	R, 6PS-S33
C103	Capacitor: fixed, paper, .033 mfd, 400 vdc	R, 6PS-S33
C104	Capacitor: fixed, ceramic, .47 mfd, 25 vdc	R, 5C11
C105	Capacitor: electrolytic, 20 mfd, 25 vdc	I, APD-046
C106	Capacitor: fixed, ceramic, .003 mfd, 1000 vdc	E, DD302
C107	Capacitor: fixed, ceramic, 1 mfd, 25 vdc	R, 5C13
C108	Capacitor: fixed, ceramic, 750 mmfd, 1000 vdc	E, DD751
C109	Capacitor: fixed, electrolytic, 100 mfd, 20 vdc	I, APD-095
C110	Capacitor: fixed, paper, 2 mfd, 150 vdc	R, 121P20591R504
C111	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	I, APD-046
C150	Capacitor: fixed, electrolytic, 100 mfd, 20 vdc	I, APD-095
C151	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	I, APD-046
C152	Capacitor: fixed, paper, .0096, 100 vdc	R, 194P96251
C153	Capacitor: fixed, paper, .0096, 100 vdc	R, 194P96251
C156	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	I, APD-046
C157	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	I, APD-046
C158	Capacitor: fixed, paper, 50 mfd, 75 vdc,	R, D27359
C159	Capacitor: fixed, electrolytic, 100 mfd, 20 vdc	I, APD-095
R01	Resistor: fixed, composition, 750 ohm ±5%, ½ w	A, EB7515
R02	Resistor: fixed, composition, selected value	A
R03	Resistor: fixed, composition, selected value	A
R101	Resistor: fixed, composition, 820 K ±5%, ⅓ w	A, EB8245
R102	Resistor: fixed, composition, 6.8 K ±5%, ½ w	A, EB6825
R103	Resistor: fixed, composition, 6.8 K ±5%, ½ w	A, EB6825
R104	Resistor: fixed, carbon, 60 ohm ±1%, ⅓ w	J, CEC-TO
R105	Resistor: fixed, composition, 220 K ±10%, ½ w	A, EB2241
R106	Resistor: fixed, composition 6.8 K ±5%, ½ w	A, EB6825
R107	Resistor: fixed, composition, 910 ohm ±5%, ½ w	A, EB9115
R108	Resistor: fixed, composition, 150 ohm ±5%, ½ w	A, EB1515
R109	Resistor: fixed, composition, 10 K ±10%, ½ w	A, EB1031
R110	Resistor: fixed, composition, selected value	A
R111	Resistor: fixed, composition, 6.8 K ½ w, ±5%	A, EB6825
R112	Resistor: fixed, composition, 1.3 K ±5%, ½ w	A, EB1325
R113	Resistor: fixed, composition, 47 ohm ±10%, ½ w	A, EB4701
R114	Resistor: fixed, wirewound, 900 ohm ±1%, 3 w	R, 451E9011
R150	Resistor: fixed, composition, 82 K ±10%, ½ w	A, EB8231
R151	Resistor: fixed, composition, 10 K ±10%, ½ w	A, EB1031
R152	Resistor: fixed, composition, 3 K ±5%, ½ w	A, EB3025
R153	Resistor: fixed, composition, 200 ohm ±5%, ½ w	A, EB2015
R154	Resistor: fixed, composition, 1.5 K ±10%, ½ w	A, EB1521
R155	Resistor: fixed, composition, 100 K ±10%, ½ w	A, EB1041
R156	Resistor: fixed, composition, 100 K ±10%, ½ w	A, EB1041
R157	Resistor: fixed, composition, 10 K ±10%, ½ w	A, EB1031
R158	Resistor: fixed, composition, 1.5 K ±10%, ½ w	A, EB1521
R159	Resistor: fixed, composition, 27 K ±5%, ½ w	A, EB2735
R160	Resistor: fixed, composition, 200 ohm ±5%, ½ w	A, EB2015
R161	Resistor: fixed, composition, 2 K ±5%, 2w	A, EB2025

Wm. BARPLE

TABLE OF REPLACEABLE PARTS

Circuit Ref	Description	Mfr* & Mfr's Designation
R162	Resistor: fixed, composition, 47 ohm ±10%, ½ w	A, EB4701
R164	Resistor: fixed, composition, selected value	A
R201	Resistor: fixed, carbon, 33.333 K ±1%, ½ w	J, CEC-TO
R202	Resistor: fixed, carbon, 16.361 K ±1%, ½ w	J, CEC-TO
R203	Resistor: fixed, carbon, 8.585 K ±1%, ½ w	J, CEC-TO
R204	Resistor: fixed, carbon, 4.653 K ±1%, ½ w	J, CEC-TO
R205	Resistor: fixed, carbon, 2.563 K ±1%, ½ w	J, CEC-TO
R206	Resistor: fixed, carbon, 1.413 K ±1%, ½ w	J, CEC-TO
R207	Resistor: fixed, carbon, 796.9 ohm ±1%, ½ w	J, CEC-TO
R208	Resistor: fixed, carbon, 10.939 K ±1%, ½ w	J, CEC-TO
R209	Resistor: fixed, carbon, 17.094 K ±1%, ½ w	J, CEC-TO
R210	Resistor: fixed, carbon, 20.55 K ±1%, ½ w	J, CEC-TO
R211	Resistor: fixed, carbon, 22.5 K ±1%, ½ w	J, CEC-TO
R212	Resistor: fixed, carbon, 23.594 K ±1%, ½ w	J, CEC-TO
R213	Resistor: fixed, carbon, 24.21 K ±1%, ½ w	J, CEC-TO
P01	Potentiometer: carbon , 2.5 K ±10%, 2 w	A, CU2521
P101	Potentiometer: wirewound, 50 ohm	N, 5024
P102	Potentiometer: wirewound, 400 ohm	F, CM22425
P103	Potentiometer: wirewound, 2 K	N, 5105
P104	Potentiometer: wirewound, 2 K	N, 5105
LP101	Lamp: tungsten (used as resistor) 4 w, 120 vac	H, ~~T4½~~ NEC-100
J01	Jack: (LINE) Type 310	S, L-12B
J02	Jack: (EXT) Type 310	S, L-12B
J03	Pin Jack: (case ground)	P, 241
J04	Jack: (EXT OSC network)	B, 126-218
BP01	Binding Post: (LINE) brass, nickel plated	P, 137-SP
BP02	Binding Post: (LINE) brass, nickel plated	P, 137-SP
BP03	Binding Post: (EXT) brass, nickel plated	P, 137-SP
BP04	Binding Post: (EXT) brass, nickel plated	P, 137-SP
BP05	Binding Post: (SLEEVE) brass, nickel plated	P, 137-SP
BP06	Binding Post: (SLEEVE) brass, nickel plated	P, 137-SP
S01	Switch: rotary, 5 position, 8 pole (FUNCTION)	E, PA1027
S02	Switch: rotary, 2 position, 2 pole	L, 3222J
S03	Switch: toggle, DPDT	P, 81027-CH
S04	Switch: toggle, SPST (POWER)	P, 81015-BP
S05	Switch: toggle, SPST (HOLD)	P, 81015-BP
S06	Switch: toggle, SPST (IMP)	P, 81015-BP
S07	Switch: toggle, DPDT	P, 81027-CH
S08	Switch: toggle, DPDT	P, 81027-CH
S201	Switch: rotary, 7 position, 3 pole (REC LEVEL)	E, PA1009
S103	Switch: rotary, 9 position, 4 pole (OSC FREQ)	E, PA1014
T01	Transformer: receive	O, NEC-NES1996C
L01	Inductor: series, 3.17 henry	O, NEC-NES-TN1274
Q101	Transistor	U, 2N1374 or equivalent
Q102	Transistor	U, 2N1374 or equivalent

TABLE OF REPLACEABLE PARTS

Circuit Ref	Description	Mfr* & Mfr's Designation
Q103	Transistor	U, 2N1374 or equivalent
Q104	Transistor	U, 2N1374 or equivalent
Q105	Transistor	U, 2N2102 or equivalent
Q106	Transistor	U, 2N2102 or equivalent
Q107	Transistor	U, 2N2102 or equivalent
M01	Meter: special	O, NEC-15B-A1151-E5.3
D101	Diode	T, 1N198
D102	Diode	T, 1N198
D103	Diode	T, 1N198
D104	Diode	T, 1N198
	Battery: 9 volts (2 per set)	G, 2356
	Knob: switches S01, S201, S301	Q, 70-3-2
	Knob: switch S02	Q, 70-1WD-2
	Knob: potentiometer P01	Q, 70-1-2

Replaceable Parts Used Only in TTS 15C

CR1	Diode	T, 1N2069
CR2	Diode: zener	M, 1N3795B
E1	Battery: 1.5 volts (10 per set)	G, 950
J01	Jack: (LINE) Type 310	S, 5J-1329
J02	Jack: (EXT) Type 310	S, 5J-1329
J05	Jack: (48V) Type 310	S, 334-F
R04	Resistor: fixed, wirewound, 600 ohm ±5%, 3 w	R, 242E-6015
R05	Resistor: fixed, metal film, 17.094 K ±1%, ½ w	J, CEC-TO
S01	Switch: rotary, 5 position, 6 pole (FUNCTION)	E, PA1021
S04	Switch: toggle, DPDT	P, 81027-CH
S09	Switch: pushbutton	S, 903

*See List of Manufacturers Code Letters for Replaceable Parts Table

LIST OF MANUFACTURERS CODE LETTERS

Code Letter	Manufacturer
A	Allen Bradley Company
B	Amphenol Corporation
C	Arrow-Hart and Hegeman Electric Company
D	Automatic Electric Company
E	Centralab
F	Clarostat Manufacturing Company
G	Eveready (Union Carbide Corporation)
H	Herzog Miniature Lamp Works, Inc.
I	International Electronic Industries
J	IRC, Inc.
K	Kurz-Kasch, Inc.
L	P. R. Mallory and Company
M	Motorola
N	The Muter Company
O	Northeast Electronics Corporation
P	H. H. Smith Company
Q	Raytheon Company
R	Sprague Electric Company
S	Switchcraft, Inc.
T	Sylvania Electric Products,Inc.
U	Texas Instruments, Inc.

MODELS TTS 15XV AND TTS 15CXV VARIABLE FREQUENCY COVERS

1.0 GENERAL

1.01 The Models TTS 15XV and TTS 15CXV accessory covers contain an external frequency determining network for the oscillator in the TTS 15B and TTS 15C Transmission Test Sets respectively. They provide a continuously variable frequency coverage from 200 cps to 7000 cps in three ranges. The TTS 15XV and TTS 15CXV are identical except for physical size.

1.02 The TTS 15XV or TTS 15CXV should be used only with the unit to which it is attached when purchased. If it is used with any other set, the frequency calibration will not apply.

1.03 The TTS 15XV is housed in a detachable cover 6" wide by 8" high by 4¼" deep. Its weight is 2½ pounds.

1.04 The TTS 15CXV is housed in a detachable cover 6" wide by 9" high by 4¼" deep. Its weight is 3 pounds.

2.0 TRANSMISSION PERFORMANCE

2.01 The frequency range of 200 cps to 7000 cps is covered in three ranges selected by a three position range selector switch:

200 - 700 cps
600 - 2100 cps
2000 - 7000 cps

A continuously variable adjustment controls the frequency in each range.

2.02 The output level of the oscillator is constant within ±0.30 db with frequency and the frequency accuracy is within 3% when used with the basic unit with which it has been calibrated.

2.03 The circuit daigram of the variable frequency network is shown in Fig. 8.

3.0 OPERATION

3.01 Plug the connector at the end of the cable in the cover into the connector on the TTS 15B or TTS 15C which is adjacent to the last position of the SEND FREQ switch.

3.02 Turn the SEND FREQ switch to the position pointing to the connector.